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Exploring Instructional Design in Mathematics of Meister High School for Improving Vocational Competency

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Abstract

This paper attempts to design instructional model in mathematics for improving vocational competencies, the primary educational goal of Meister high schools. This paper offers the PICME concept made up five components: Problem solving, Information processing, Communication, Mathematics, emotion. This model can be utilized effectively in developing learner's the five factors through math class.

Keywords: *Vocational competency, Mathematics, Curriculum design*

1. Introduction

The keystone of curriculum revision issued 2015 is cultivating creative and convergent human resources for normalization of public education. That is, the revised curriculum proposes the characteristics of creative and convergent human resources which knowledge and information society require; thus, to rise such talented individuals six core competences are necessarily needed: self-management, creative thinking, communication skill, information processing skill, aesthetic discernment, a sense of community and fellowship [1].

Meister high schools have stressed both the development of foundational competence and task skills based on National competency standards and it is regarded as considerations for the organization of the curriculum in component schools. However, Meister high schools mainly focus on specialized subjects than regular subjects (e.g. math). For this reason, math is not being given enough priority or time of which is an essential element of the learners' relative majors. Notably the above core competences referred on revised curriculum are relevant to the competencies highlighted in math education sector such as creativity, convergence, communication skills, information literacy, practical capacity; besides the sub-elements of vocational competency (e.g. mathematical skill, problem-solving ability, self-improvement skill, information processing skill, sociality) are related to the core competencies in math education. Given these considerations, the competencies and skills would be able to develop through mathematics education.

According to RISS search criteria, the total number of previous studies as per math education in Meister high schools and specialized high schools are 32 (i.e. master's thesis (28), scholarly journal papers (4)). These studies do not differentiate specialized high schools from Meister [1]high schools; thus, I review both type of schools on the same level. Looking at briefly main topics in past studies, above all research on math

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education in Meister high schools deal with beliefs about mathematics, the status of math education, awareness of basic math textbook, and the realities of schoolwork [2][3][4][5][6][7]. The studies as to teaching material development are the effect of the reorganized textbook by the mathematical connection with electric circuits, an effective method for math education, teaching materials for vocational education and development of remedial learning program [8][9][10][11][12][13]. With reference to the combining math bandleaders' majors, there are a total of six research such as analysis on correlation between mathematics curriculum and specialized curriculum, a connection between math financial assets marketing study, on connectivity between high school cost accounting and middle school mathematics, study for relationship between professional curriculum for department of semiconductor display [8][14][15][16][17][18]. Studies dealing with teaching methods are effects of mathematics lessons with Jigsaw model on the learner's affective development, an effective way to improve task commitment in teaching mathematics, and a study on the teaching of the characterized high school mathematics [19][20][21][22]. Research on methods of teaching concepts are a study on formational of the process-object perspective of function using excel to specialized high school math underachievers, and effect of teaching numeral system with the concept of bunches about the achievement and mathematical attitude [23][11]. Lastly, studies with regard to curriculum design are analysis on the mathematics curricula of specialized alternative high schools and analysis on the mathematics curricula of Meister high school [24][25].

Upon reviewing of the previous studies, there is no research conducted on instructional design in mathematics of Meister high schools. Furthermore, there are only four empirical studies as to teaching methods and six studies on mathematics consolidated into majors but limited material development for certain subjects. Therefore, I attempted to design instructional model for math education of Meister high schools to improve vocational competency which is the educational goal of Meister high schools. For this, I analyzed sub-elements of vocational competency and core competencies in math education; in doing so, I suggested some steps and requisite learner's abilities at each step.

2. Methodology

Data was obtained from a mix of methods: document analysis, questionnaire survey. Firstly, I analyzed National competency standards (Henceforth NCS) and national curriculum 2015.Secondly, a total of 271 students from 'A' Meister high school answered the survey.

2.1. Research procedure

I abstracted the main factors needed for math education in a Meister high school from the survey findings. By analyzing the sub-elements of NCS vocational competency and the core competencies in math education, I tried to identify common elements or any direct correlation between them. Also, I discussed with educationalists how to develop NCS vocational competency through math education in Meister high schools.

3. Result

3.1. Data- A survey of student perceptions and experiences toward math education

I examined student perceptions and experiences toward math education by conducting a questionnaire survey on 271 students, who were in 2nd year at a Meisterhigh school. The survey consists of 6 questions designed multi-choice type as shown below [Table 1].

Table 1. Student questionnaire

Questions	Contents
1	How much are you interested in math learning?
2	How long do you spend time for math study?
3	How much do you understand the content you learn in math class?
4	What do you do when you cannot understand some content?
5	Do you have any suggestions or ideas for effective math learning?
6	What kind of lesson do you prefer?

Firstly, the answer to the first question shows that more than half of participants (60%)had no mathematical interest; thus, it suggests that teachers make more efforts to stimulate them to be interested in studying math. The answer to the second question shows that 95%participants usually did not study math except exam period; therefore, it suggests that teachers make more effective lesson plans to guide students to study steadily.

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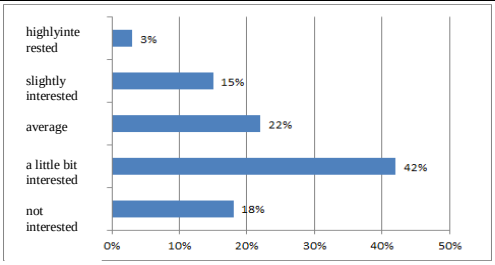
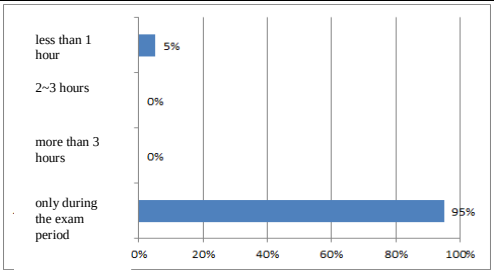
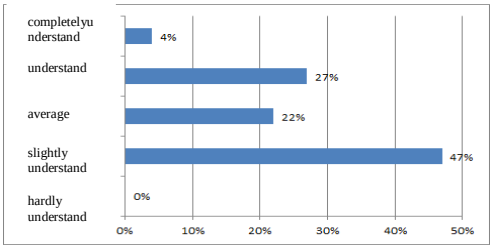
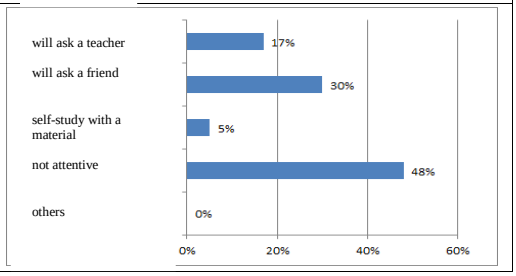
1		2	
3		4	

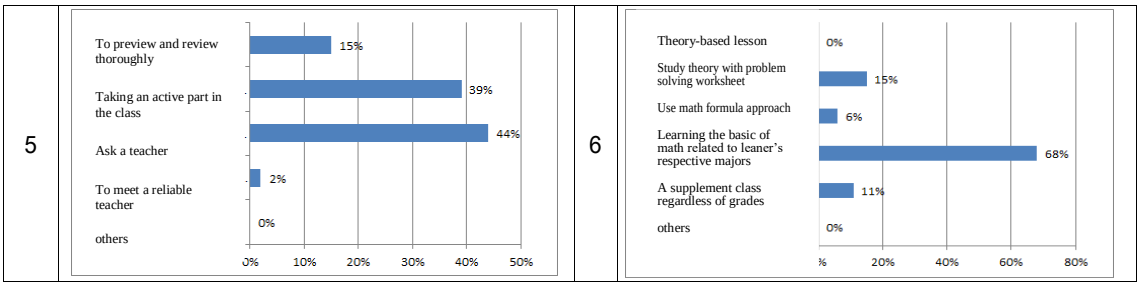


Figure 1. Learning result

The third question is to identify their intelligibility in math class; the result shows that 69% participants suffered comprehension difficulty in lesson; thus, it means teaching instruction must be improved. With this, the fourth question is to identify how participants react when they suffer comprehension difficulty in math class. According to the findings, 48% did not do anything for comprehension improvement; 30% got help from their friends; 17% asked their math teacher; 5% studied by themselves. It should be noted that minimal effort to improve would just create constant problem and worst of all, it might lead to giving up. Therefore, it would be worthwhile if math teachers pay attention on this issue. The answer to the fifth question, 44% responded math teacher's comprehension check may increase to study math of greater interest; 39% answered taking an active part in the class; 15% said to prepare and review thoroughly. The findings show that participants were aware of the importance of clarifying the math lesson content and learning attitude. Lastly, in terms of lesson type preference on question sixth, 68% answered learning the basics of math related to leaner's' respective majors; 15% were to study theory with problem solving worksheet; 11% preferred a supplement class regardless of grades. Consequently, it is suggested that the math class of Meister high schools be articulated with learners' respective majors.

3.2. Data- instructional design in mathematics of Meister high school for improving vocational competency

To begin with, among NCS vocational competencies I selected five elements which are necessary needed to improve vocational competence such as problem solving, information processing, communication, mathematics, and emotion (i.e. interpersonal relational & professional Ethics & self-development).

This is because these five factors are particularly related with the core competencies in math education. Next, I grafted them upon flipped learning; in doing so, two expectancy effects would be suggested: firstly, a learner could develop the abilities in math class; secondly, by designing learner centered class it would be possible individual tutorials and repeated practices. The below schematized data shows each step and factors of instructional design in mathematics of Meister high school for improving vocational competency [3-1].

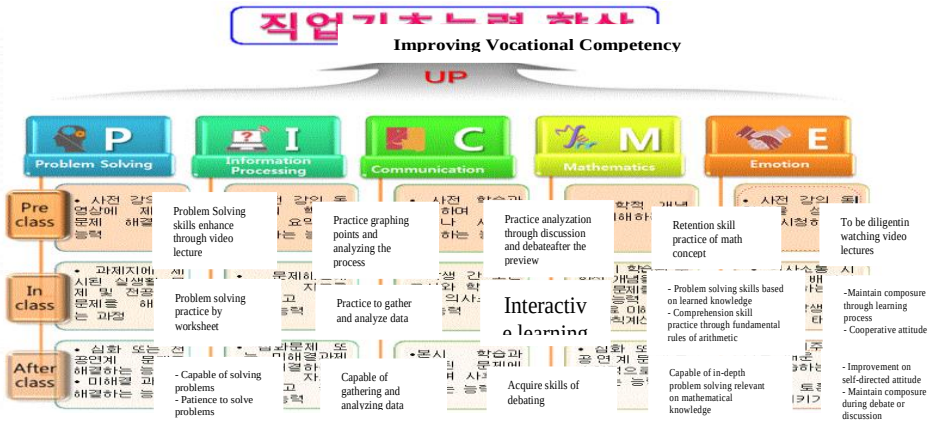


Figure 2. Improving vocational competency

The longitudinal components are composed of Pre-class, In-class, After-class. The horizontal axis addresses leaner's five activities at each step: Problem solving, Information processing, Communication, Mathematics, emotion. Mentioning activities (or role) and skills at each steps in more detail, firstly, in 'Pre-Class', the activities for teacher are making online lectures, making worksheets for preview and tasks; the activities for student are pre-watching online lectures(E), solving problems provided from online lectures(P), filling out worksheets (I, M),making question lists if they have any (C). In this regard, pre-watching video lectures means an activity for self-development with a self-directed learning method so that it is categorized as 'E'; solving problems on online lectures is classified as 'P' since it is about problem solving; filling out worksheets requires both information processing abilities and mathematical skills so that it represents 'I, M'; making question lists based on preview worksheets is to create opportunities for interactivity, hence it represents 'C'. Secondly, in 'In-Class', the teacher's role is to manage learner-centered class (e.g. group activity, discussion); the activities for students are data collecting for task(I), work in group/discussion (P, M, C), developing team-work skills (E).In this, data collecting for task requires information processing skill, thus it is classified as 'I'; work in group or debating for task requires problem solving skills, mathematical skills and communication skills so that it is 'P & M & C'; team-work skills mean being good at dealing with interpersonal relation, hence it is 'E'. Thirdly, in 'After-Class', the teacher's role is to provide feedback and test learners; the activities for students are completing unsolved tasks through group discussion (P, I, C, M), having good interpersonal skills in group and self-directed learning (E). Because these activities are done on the last stage, integrative capacities (i.e. information processing skills, communication skills, problem solving skills, team-work skills) are required; thus, these are represented in 'P & I & C & M & E'.

4. Conclusion

This research was conducted to develop instructional design in mathematics of Meister high schools for improving vocational competency. I suggested an instructional design model in mathematics. The aim of it is to improve vocational competencies suggested by NCS and strengthen mathematical abilities stressed by curriculum revision

2015 and meet the needs of students. In terms of learning abilities, I was considered five main factors: Problem solving, informational processing, Communication, Mathematics, Emotion (i.e. Interpersonal relation& professional ethic & Self-development). Particularly, mathematical skills and problem-solving skills would be applicable to other subjects or schools for more effective teaching-learning-method.

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